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FOCUS ON RESEARCH

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**A LOOK INTO
WOOD UTILIZATION
RESEARCH ACTIVITIES
OF THE
FOREST SERVICE**

PREFACE

Timber is one of the Nation's basic raw materials. In 1958, nearly 6 percent of the gross national product, or about 25 billion dollars, originated in timber-based economic activities. Employment attributed to timber in all timber-based industries amounted to the equivalent of 3.3 million people—about 5 percent of total employment.

The purpose of this report is to describe the means by which the Forest Service, U.S. Department of Agriculture, is approaching the public need for research in the effective and economical utilization of our extensive and renewable timber resources.

The mainspring of the Forest Service system of products research is its U.S. Forest Products Laboratory on the campus of the University of Wisconsin in Madison, Wis. Reaching out from this center are its wood utilization facilities at regional Forest and Range Experiment Stations. These are designed to reach into all geographic areas of the country. The close relationship and coordinated program objectives of the national Laboratory and the regional units are described in the pages that follow.

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Many apparently healthy Douglas-firs contained fungus-damaged wood which research was able to transform into profitable products.

FOCUS ON RESEARCH

A Look Into Wood Utilization Research
Activities of the Forest Service

UPGRADING WOOD PRODUCTS THROUGH TEAMWORK

To an untrained eye, the majestic old stands of Douglas-fir west of the Cascades are a lumberman's dream of healthy, defect-free timber. Yet many of these trees are internally scarred by a fungus growth that has pock-marked the wood and made it commercially unusable; that is, until recently. It took more than a decade of teamwork among Forest Service wood specialists and industry to set up standards convincing the consuming public that wood marked by the "white pocket" defect could be used satisfactorily as good structural lumber, plywood, and pulp. These wood specialists were



M-100461

Walls of good acoustical properties used in offices and public rooms are made from Douglas-fir timber affected by "white pocket."



as far apart geographically as the regional Pacific Northwest Forest and Range Experiment Station in Portland, Oreg., and the U.S. Forest Products Laboratory at Madison, Wis. In 1947 the Pacific Northwest Station brought the problem to the attention of the national Laboratory and supplied it with old-growth Douglas-fir logs containing varying degrees of white-pocket material. Several years of comprehensive research followed, studying and exploring the characteristics and capabilities of this "defective" material. Financial help from industry was sought, and was given by the Douglas Fir Plywood Association.

At the same time the pulping properties of white-pocket material were investigated by a team representing the Station and the Laboratory. The pulp and paper industry supported additional pulping research and now uses large volumes of white-pocket material.

The final result was industry and consumer acceptance, and the manufacture of products valued annually at more than \$100 million from material that might otherwise have gone to waste.

A NEW INDUSTRY FOR THE SOUTH

In another region of the country, recent cooperative efforts of a Forest Service regional Experiment Station and the Forest Service's national Forest Products Laboratory also paid off in regional and national benefits. Previous studies, dating back to 1945, had shown it was

then impractical to establish a plywood industry in the South based on the southern pines as raw materials. These studies at the Laboratory had been conducted with the support of the Southern Forest Experiment Station at New Orleans, La. As time went on, circumstances changed. The quality of southern pine improved in many parts of the South, demand for plywood increased on a national scale, and favorable economic factors developed.

In 1960 new studies were begun. A team composed of specialists from the Laboratory and the Station surveyed the quality of the raw material and collected samples. The following year the national Laboratory began developmental work. Soon the Laboratory became convinced that the time was ripe for a new industry in the South. Businessmen were informed of the possibilities and, in cooperation with the Forest Products Laboratory, drafted commercial standards which were sent to the U.S. Department of Commerce. This was the first time such standards had ever been established for a product before plants were set up for production.

The groundwork was thus laid for an industry that should add many millions of dollars annually to the economy of the South. The U.S. Forest Products Laboratory had combined its know-how, based on decades of work on west coast plywood, with the Southern Experiment Station's knowledge of the region's timber resources and economic conditions to assure the success of this venture.



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Good management of southern pines assures an abundance of timber for a new plywood industry in the South.

Southern pine veneer at the Forest Products Laboratory signals the birth of a new regional industry and is the outcome of cooperative research efforts among Government and private agencies.

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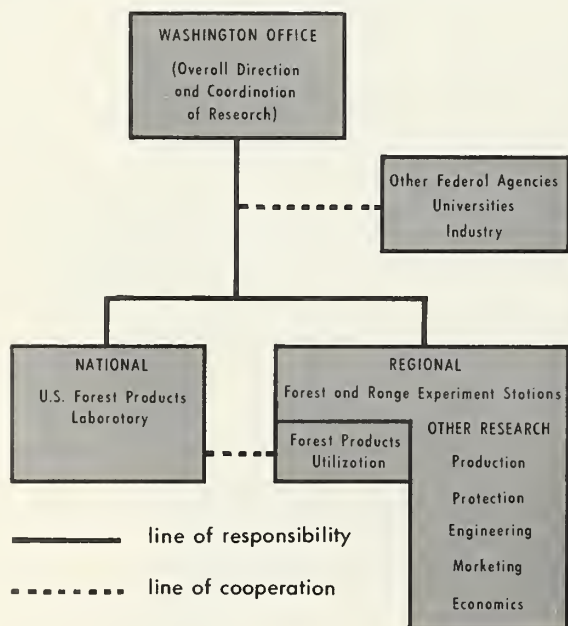
FOREST SERVICE REGIONAL EXPERIMENT STATIONS AND FOREST PRODUCTS LABORATORY



- PROGRAM LOCATIONS
- HEADQUARTERS OF REGIONAL FOREST EXPERIMENT STATIONS
- FOREST PRODUCTS LABORATORY
- ★ WASHINGTON - BELTSVILLE



System of Wood Utilization Research of Forest Service, U.S. Department of Agriculture



SOLVING PROBLEMS—A JOINT EFFORT

The foregoing are but two examples of the hand-in-glove operations of the national Forest Products Laboratory and each of the ten regional Experiment Stations of the U.S. Department of Agriculture's Forest Service. They are not isolated cases but are part of the overall pattern of cooperation characteristic of these research groups since their inception. . . . A wood utilization problem appears in a certain locality or region. It is brought to the attention of or is recognized by the Experiment Station. In some instances the wood utilization specialists at the Station will take care of it. If the problem requires more in-depth research than the Station is equipped to do, it will request aid from the Forest Products Laboratory. There, the combined efforts of various scientists and technicians are brought to bear on the problem until it yields to an acceptable solution. The findings are then fed back to the regional area where they can be put to prac-

tical use Data and experience thus amassed through the years are part of the national Laboratory's history and structure, providing precedents and procedures that can be applied anywhere in the country with appropriate variations according to tree species or natural conditions. The Experiment Stations and private industry nationwide look to the U.S. Forest Products Laboratory for central research in wood products. The Laboratory, in turn, looks to the regional stations and industry as bearers of challenging problems, as partners in the solution of them, and as disseminators and users of Laboratory basic research and the processes and findings it has developed that make for better wood utilization throughout the United States.

WOOD USE: PROBLEMS AND POTENTIALITIES

The problems of wood utilization are many and varied, touching on all forest regions and affecting all woodland owners and processors. The wood-using industries need more and better quality trees to meet the increased market demands of the future, and new or improved wood products to stem the inroads of such competing materials as the metals and plastics. The larger operators, as well as the small operators who process a large portion of the Nation's forest products, seek ways of improving plant efficiency and profits by such means

as sawmill improvement and better wood seasoning methods.

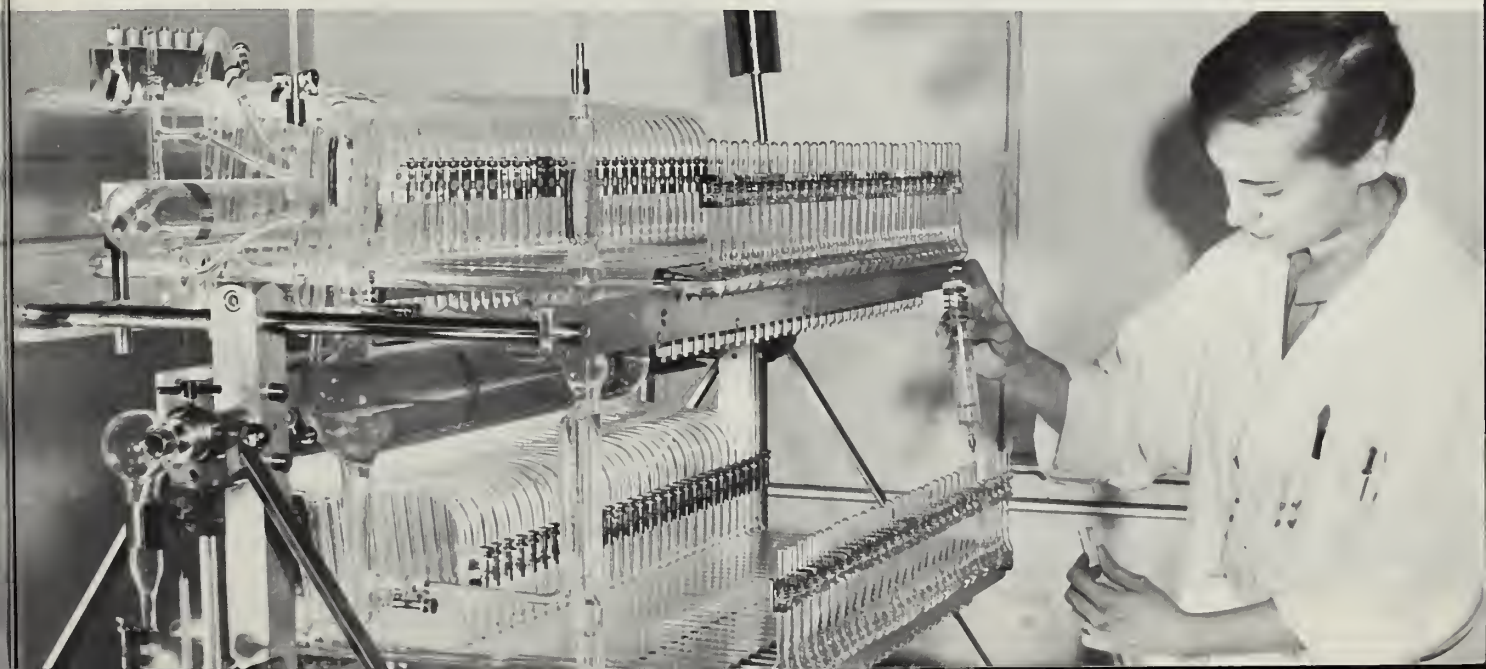
The managers of private and public forests need to know how to grow better quality wood and the effects of genetics on wood quality. The small forest owners, who number in the millions and hold more than half of the country's forest acreage, look for ways of improving their timber stands, and hope that new uses will be found for the poorer quality trees in their woodlands which at present have little commercial value.

CHALLENGES IN WOOD RESEARCH

In wood, our most valuable renewable resource, lie tremendous, untapped potentialities waiting for the methodical, practical magic of research to bring them forth. A major breakthrough in lignin knowledge, for instance, could spark the birth of a new chemical industry. Other problems are concerned with the use of low-grade hardwoods and softwoods; with the elimination or increased utilization of wood wastes resulting from logging and milling operations, wastes that reduce potential industrial profits by hundreds of millions of dollars each year; with extending the life of wood by protecting it against the damage of insects and decay; with gluing and combining wood with other materials; with better wood utilization in housing and other construction. These are but a few of the research problems whose solution, as have other solutions or discoveries in the past, will benefit everyone from the timber producer or processor to the final consumer.

Wood chemistry is on the brink of new and revolutionary discoveries in wood utilization.

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Dealing with regional and national wood utilization problems is a major Forest Service responsibility. This mammoth task involves many techniques and disciplines; intensive and often long-range research projects and studies; and a nationwide program of Federal, State, and private cooperation touching on all forest regions. To cope with this responsibility most effectively, the Forest Service established a central wood products laboratory to work in harmony with 10 regional experiment stations. Overall administration and coordination of the research is provided by a staff under the leadership of a Forest Service Deputy Chief in Washington, D.C.

THE FOREST PRODUCTS LABORATORY: FOCAL POINT FOR NATIONWIDE WOOD RESEARCH

This central laboratory known as the U.S. Forest Products Laboratory was established in 1910 on the campus of the University of Wisconsin at Madison, Wis. Its mission is to work on problems that have broad national implications and it does both fundamental and applied research but with emphasis on the more basic problems. The Laboratory takes in the whole Nation as its province embracing every

region and State. Within a frame that envisions a proper balance between fundamental and applied research in a diversity of forest regions, and recognizes that in wood the variation in properties between species is often less than the variation within species over extensive geographic areas, the findings of the Laboratory mostly have that quality which makes them adaptable or applicable anywhere in the country at the least possible cost.

CONCENTRATION AND COOPERATION

The U.S. Forest Products Laboratory is manned by a capable force of career scientists, engineers, and technicians equipped with complex machines and precision scientific devices, many of which were developed at the Laboratory. Their work spreads over four major fields of wood utilization: lumber and other solid wood products; wood engineering and packaging; pulp, paper, and chemical products; and wood quality.

Wood is the common denominator that unites all efforts of the Laboratory into a generally cohesive program. To make this raw material more serviceable and usable, to better preserve it against all possible forms of destruction, to pluck at its complex composition so that it can assume new forms and new uses, to upgrade its remarkable properties by improving the wood quality in the standing tree—these are a few of the tasks that challenge the capability of the Laboratory's human and mechanical resources.

The U.S. Department of Agriculture's nerve center for research in wood utilization is the Forest Products Laboratory in Madison, Wis.

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The atmosphere of the Laboratory is not the ingrown calm of an ivory tower. Its doors are open to wood utilization problems that tax the industry and the Nation; its findings are open and available to anyone who can use them. It does not work alone, nor does it favor any particular interest. It has been a boon to the large number of wood products businesses that are too small in size and earnings to afford their own research and development staffs, while it also cooperates with the larger companies on research of joint interest. Cooperation with all interested elements is the key that has unlocked the door to a multitude of new wood discoveries and new wood uses—cooperation with other Federal agencies, with other research laboratories, with private industry large and small, with individuals, with universities. As the center of Forest Service wood research, the national Laboratory also has its fingers on the pulses of the 10 regional Experiment Stations, absorbing some of their wood problems and feeding them research results that can be applied to their specific areas.

MEETING A PROBLEM OF BROAD SCOPE

Better information on timber quality is one of the broad problems being tackled by the national Laboratory in cooperation with others. The quality of timber bears importantly upon the cost, strength, durability, beauty, and other criteria by which wood products are judged. Specific gravity, or wood density, is the most useful index to such quality factors as strength, hardness, and associated physical properties.

Several years ago, the Laboratory developed reliable methods by which the specific gravity of our softwood timber resources can be determined. These methods include the extraction of an "increment core" from trees selected in the forest under a carefully devised sampling plan. With the help of the Stations, "core-density surveys" have been made a part of the Stations' forest survey and are in progress, or have been completed, in most of the South, Maine, and in 11 Western States. Some of the States, universities, and industry have also cooperated in this nationwide project. Western industry, for example, has contributed \$300,000 toward the cost of core collection, Laboratory



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A scientist at the Southern Forest Experiment Station collects cores and wood specimens in a cooperative research project with the national Forest Products Laboratory.

analysis, and data processing by electronic computer.

The core-density surveys are adding much to our knowledge of the quality of the forest resource. The findings are expected to be of great value in the management and harvesting of forests; in the manufacture and marketing of lumber, paper, plywood, and other products; and in the more efficient utilization of wood in construction.



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EXPERIMENT STATIONS: PUTTING RESEARCH TO WORK REGIONALLY

Experiment Stations, as regional arms of the Forest Service research organization, came into being in 1908. Today, after several changes, additions, and consolidations, 10 Forest and Range Experiment Stations are spaced throughout the United States, extending from the northern region of Alaska to the Southeast, and from the Northeast to the Pacific Southwest. In Puerto Rico, the Institute of Tropical Forestry covers the U.S. Caribbean area.

These Stations with their constituent laboratories and experimental forests and ranges are major field units of the Forest Service, essentially concerned with regional problems as these bear on public and private forest and range lands. Forest products utilization is but one of many research areas of the Stations. Others include forest and range management for the production of timber, water, forage, wildlife habitat, and recreation; protection of the forest and range resources from fire, insects, and diseases; and studies in forest engineering, economics, and forest products marketing.

AN EXPERIMENT STATION AT WORK

Typical of these regional research units is the Southeastern Forest Experiment Station,

headquartered in Asheville, N.C. Its area of responsibility includes Virginia, North Carolina, South Carolina, Georgia, and most of Florida. These States contain over 93 million acres of forest land, including about 5 million acres of National Forests in addition to numerous private holdings, ranging from small-farm size to extensive acreages. The Station does research from nine principal locations where it maintains laboratory facilities with nearby experimental forests and demonstration areas.

Most of these locations are centers for research on regional problems concerned with the management and protection of forests to enhance the utility of the multiple products and services to be derived from the forest resource. One of the locations—on the campus of the University of Georgia at Athens, Ga.—has laboratory facilities for wood utilization studies which are operated by the Station with the cooperation of the U.S. Forest Products Laboratory at Madison, Wis. The forest products studies of the Station deal with regional problems and in effect constitute a field arm for the national Laboratory where both national and regional studies are brought to bear on southeastern wood utilization problems.

In addition to these regional utilization

Typical of recently improved facilities to speed research in forest production is one of the laboratories of the Lake States Forest Experiment Station, the Silviculture and Watershed Laboratory on the North Central campus of the University of Minnesota at Grand Rapids.

The Pacific Northwest Station participates in a wood density survey, a nationwide project.



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studies, the Station conducts from its Asheville, N.C., headquarters a continuing forest resource survey and related economics studies, all bearing on an appraisal of the timber supply and the use of timber in the Southeast. Data on the location, species, growth, volume, and quality of the region's timber are compiled, as well as the volumes harvested and used by the forest industries. Connected with this survey, and in cooperation with the Forest Products Laboratory, is the core-density study already described. Knowledge gained from the forest survey in the Southeast, along with a similar study by the Southern Station at New Orleans, La., has recently been instrumental in establishing the multi-million dollar southern pine plywood industry.

REGIONAL STAFF OF WOOD EXPERTS

Forest utilization research within the Station organization is attuned to the needs of the re-

gion. The staff of utilization technologists, for example, may work with small sawmill operators to identify and solve some of their problems. Or it may engage in a study aimed at increased regional use of low-grade hardwood lumber. In many of the studies the Station seeks the help of the national Forest Products Laboratory, and cooperates with university or industry research agencies in seeking solutions.

The regional staff of wood utilization specialists also provides consultation and advice to industry and extension agencies, and maintains close liaison between non-Federal research groups and the Forest Products Laboratory. The Station thus acts as an exchange point between research and problem areas, adapting Laboratory results and possible solutions to technical difficulties encountered by the woodland owner or the wood-using industry.

SOME MAJOR ACHIEVEMENTS

As a result of the widespread team effort between the national Laboratory and the regional Stations and their combined cooperative efforts with non-Federal agencies, new industries and new forest products have been added to the American scene. The list is long, for widely used wood becomes even more versatile as research penetrates deeper into its secrets and technology transforms it further.

The "stressed skin" principle, for example, is one of the Laboratory's significant contributions to prefabricated housing. Most of the 160,000 prefabricated houses erected yearly, and sold for about \$1.5 billion, use mass-produced house panels which are based on the "stressed skin" principle of design. This pioneering research and development in the use of plywood accounts in part for the increase in Douglas-fir plywood production from 3 billion square feet in 1952 to over 10 billion square feet in recent years.

Semichemical and cold soda pulping processes developed at the Laboratory have given new economic life to many areas. Recently these processes were being used at 57 mills which produced annually 2.5 million tons of pulp. The end products of this pulp had a value of about \$750 million. Low-quality

hardwoods are used primarily and these processes can be given much credit for the current consumption of nearly 10 million cords of forest-surplus material.

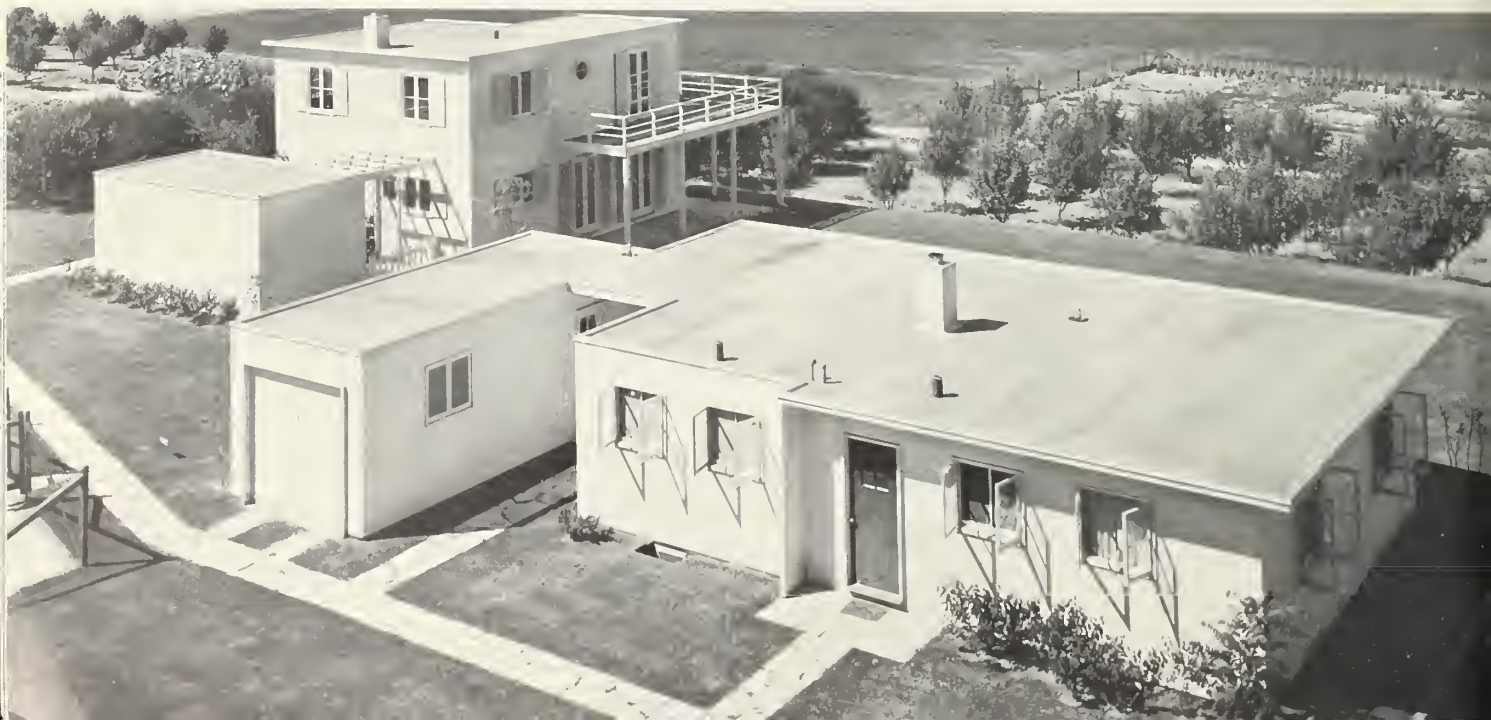
STIMULANTS TO PROGRESS IN WOOD USE

The list grows as the national Laboratory and the regional Experiment Stations are spurred by wood problems posed in times of peace and war—laminated arches, highly stable veneer-lumber flooring, improved packaging methods, internal-fan dry kilns, useful fiberboards, stronger adhesives, plastics, dimensional-stabilized wood, pentachlorophenol treatment to increase wood life, tree and log grading standards. The economic results of these findings are statistically measurable in billions of dollars, account for the livelihood of many thousands of individuals and numerous communities, and contribute to the comfort and well-being of the American people.

In many instances, new knowledge and techniques have been the response of research to local area or industry problems. Many of these problems are of a changing and continuing nature, therefore requiring a strong, continuing research program. Stimuli to a greater research effort include the growing competition

Prefabricated houses at the U.S. Forest Products Laboratory test the results of early research in this form of housing construction.

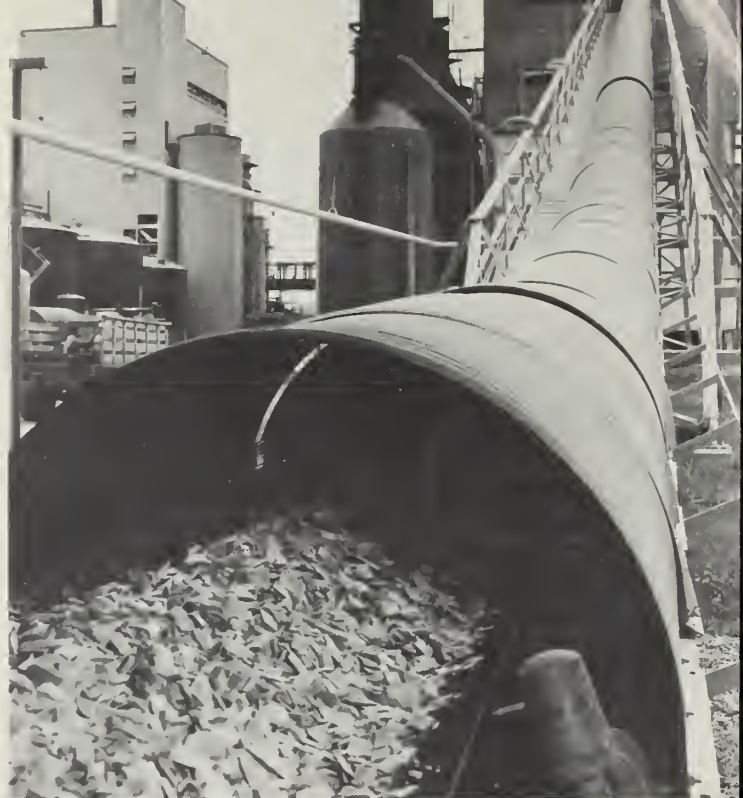
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Wood research involving the Experiment Stations and the national Laboratory has found new uses for hardwoods that formerly had little or no commercial value.



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Forest industry, spurred by consumer needs for wood products, looks increasingly to research for expanded uses of wood.

from other structural material; declining timber quality in second-growth stands; surplus wood in certain places; unsatisfactory performance of some kinds of wood in use; help for the small woodland owner and for the establishment of a timber industry in rural areas; and finding new products and uses that will extend the market for wood in the future.

In the past, achievements from forest products research have played an important part in the economy of the Nation. One indication is the burgeoning of new wood-using plants producing such products as paper, plywood, laminated timbers, glued products, and panel products with the prospect of even more in the future. Another is that the decreased production of lumber and some other industrial wood products since 1910 has been offset by the increase in the production of newer research-based wood products during the same period. The cooperative framework that buttresses Laboratory-Station wood research has been and will continue to be a contributing factor to these and to new developments.

LABORATORY AND EXPERIMENT STATIONS: A PATTERN OF COOPERATION

The Forest Products Laboratory, as mentioned previously, is largely concerned with timber utilization problems of national significance; the 10 Experiment Stations with problems of a regional cast. Some Laboratory programs are carried on with little or no Station participation as, for instance, basic wood chemistry research. Others, as charcoal kiln research, involve considerable Station collaboration. Relations between the Laboratory and the Stations range from a consulting and advisory role to a program shared equally with the Experiment Station. An example of the latter is a hardwood lumber yield study in which a large part of the data was collected by the Central States Station at its Carbon-dale, Ill., location, then sent to the Laboratory



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Timber from the forest, cut and labeled, comes to the national Laboratory to be studied—an example of cooperation between regional units and the central workshop in the field of wood utilization.

for analysis. The purpose was to develop techniques for determining by electronic computer the potential yields of rough parts for furniture and other fabricated products obtainable from different grades of lumber.

STATIONS' ROLE IN WOOD RESEARCH

The Stations carry on about one-third of the research in wood utilization with their own staffs. In their cooperative relations with the Laboratory, they are equipped, for example, to carry on studies in log grading as an aid to marketing and efficient processing; in environmental research as it affects wood quality in tree growth and relates to deterioration of wood in use; in engineering as it concerns timber harvesting and transportation; in some phases of wood seasoning, since atmospheric drying varies from region to region according to ele-

vation, the sun's radiation, weather, etc. They conduct wood density surveys with the help of the Laboratory and select representative raw material for studies at Madison. In addition, the Stations relate the results of Laboratory research to regional problems.

LABORATORY-STATION RAPPORT

Looking to the national Laboratory with its accumulated knowledge, its experience, its coordinated skills, and its special facilities, the Experiment Stations find an effective instrument with which to work on their specific problems. Some of the more important examples of collaboration include the following:

In the *Northeast* the joint efforts of the Laboratory and Station have greatly stimulated the industrial utilization of beech—formerly a wood species of little value. Beech is now moving rapidly to take its place among the preferred hardwoods.

In the *Central States*, research findings induced mill owners in the region to use low-grade hardwoods for pulp, which has helped boost regional pulpwood production more than 25 percent each year since 1955.

In the *Lake States*, the research has resulted in greatly increased use of overabundant aspen. This species, formerly considered a weed tree on cut-over white pine lands, has become the main source of pulpwood in this region.

In the *Southeast*, cooperative studies by the Station and Laboratory with industry have greatly reduced decay losses resulting from the outdoor storage of pulp chips. This work has already resulted in lower costs of raw material handling, has stimulated the use of pulp chips salvaged from sawmill residues, and has increased the income of lumber producers.

In the *Mid-South*, the joint efforts of research and collaboration with industrial representatives have resulted in establishing a new southern pine plywood industry. Equally important has been the work of the Laboratory and Southern Station in developing and testing

standard grades for pine and hardwood logs, applicable to saw logs purchased by thousands of southern sawmills.

In *Puerto Rico*, the Laboratory and the Forest Service Institute of Tropical Forestry have begun a dual attack on wood problems, such as the poor seasoning facilities available to the many small wood-using factories. Better wood drying is being effected by the Laboratory-developed solar drier, applicable also to lumber seasoning in many underdeveloped areas.

In *Alaska*, progress has been made in improving the lumber product and in insuring the profitable operation of the newly established sawmills. Clinics conducted by Laboratory personnel in three locations have passed on to the lumber manufacturers research-based information on efficient sawmill operation and maintenance, preferred log-conversion methods, and sawmill waste reduction.

In the *Pacific Northwest*, Station-Laboratory collaboration resulted in the industrial utilization of previously wasted white-pocket Douglas-fir. Similar efforts have encouraged the use of logging and sawmill residue in the form of pulp chips in volumes equivalent to millions of cords annually.

In the *Pacific Southwest*, results of joint research have provided the base for a western hardwood industry. They have established the practicability of utilizing a little-used resource, California black oak, for lumber and veneer, and also the practicability of kiln-drying lumber produced from this species.

In the *Rocky Mountain* area, the wood scientists have brought hope to a depressed lumber industry. New structural systems have been developed using a low grade of ponderosa pine lumber, and new outlets in the Southwest for this material are believed imminent.

In the *Intermountain* region, the high-temperature kiln-drying of softwood dimension lumber has been studied cooperatively with industry. The studies point the way toward reduced production costs and improved product quality.

In all the above instances, a recognized re-



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Wood utilization research has found better ways of cutting, grading, and seasoning lumber and of using it more efficiently.

gional problem complex enough to require more skill or information than the Station could muster to solve it was submitted to the U.S. Forest Products Laboratory for solution, often by a team approach. The required laboratory research is usually done at Madison, Wis., but scientists are often sent from the Laboratory to the Station to assist in complex on-the-ground field problems.

The Laboratory keeps informed of all regional utilization endeavors through joint meetings with Station wood specialists, correspondence, publications, technical meetings, and other means, and uses this information to formulate its research program and advise on regional programs. A mutual give-and-take approach to wood problems involving consultation and review of each other's programs tends to produce a balanced national research effort—an effort geared to show results in the fullest and most effective manner.

COOPERATION IN OTHER DIRECTIONS

OTHER FEDERAL AGENCIES

Because of its extensive background on wood, paper, adhesives, and plywood, the national Forest Products Laboratory of the Forest Service has been sought out by other Government agencies, particularly the Department of Defense, to engage in cooperative wood utilization projects. In peace and war, the Laboratory has contributed to the defense effort in many ways ranging from solving construction, maintenance, and packaging problems to writing manuals telling procurement personnel how to requisition the most economical sizes and qualities of wood materials. These joint ventures have stimulated and advanced wood research. For example, basic data on sandwich construction, conceived for the aircraft of World War II, provide structural components in buildings and transportation vehicles of today.

Recently the Laboratory's activities touched on the Department of Commerce's Area Re-development Administration and helped to create 110 new jobs in Biddeford, Maine. One of the area's main businesses was in decline because there was little demand for No. 4 common grade white pine boards. Looking to other possible wood uses, local businessmen applied to the ARA for a loan with which to start a finger-jointing and edge-gluing plant. The purpose of the plant was to fabricate clear boards using the poorer grades of lumber. ARA requested that the Forest Service investigate the proposed project. A joint study by the Forest Products Laboratory and the Northeastern Experiment Station showed that the process would be successful. The loan was granted, production started, and fabricated boards soon found a ready market at about \$200 per thousand board feet as compared with \$65 per thousand board feet when the lumber lay in the yard unwanted.

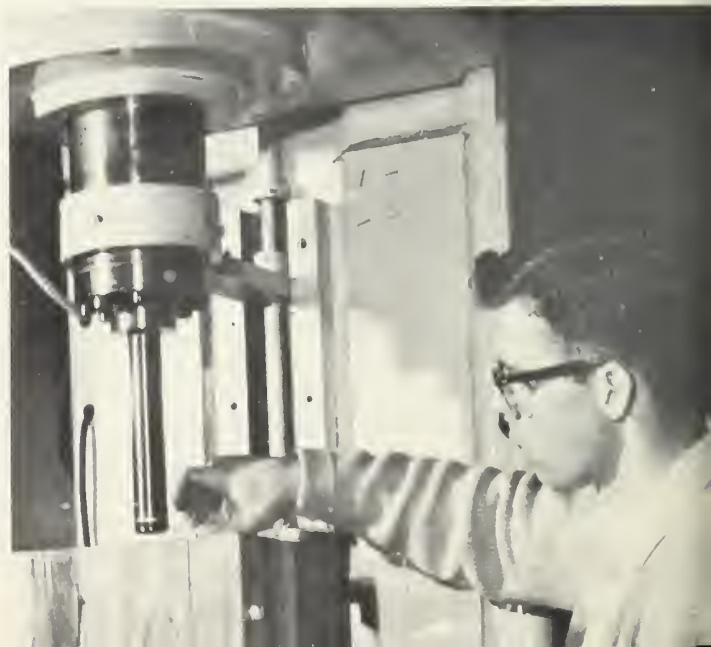
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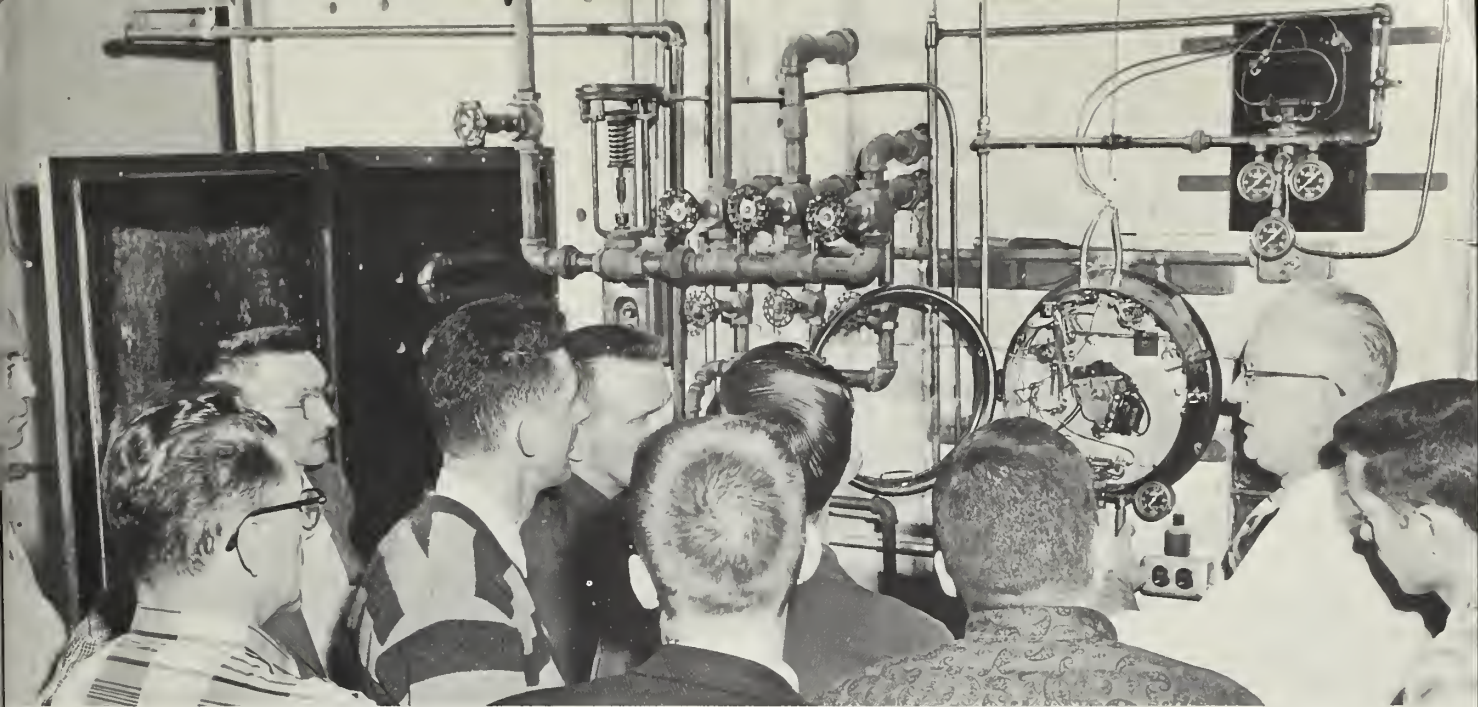
Forest utilization scientists at the Federal Forest Experiment Stations and the Laboratory assist and work with State Agricultural Experiment Stations, colleges, and universities to seek a coordinated approach in solving utilization problems. This kind of cooperation may take the form of planned programs to increase the use of certain problem species such as hickory in the Southeast, aspen in the Lake States, and beech in the Northeast; of guiding the programs of dry kiln clubs; or of assisting a regional research group in preparing work plans for its study of utility poles.

It is a Forest Service policy to provide support and opportunities to graduate students in forestry, engineering, physics, chemistry, mathematics, etc., and to build up university research programs related to wood. Colleges and universities have an important role in the total program of forest products research and fre-

A graduate student at the University of Michigan operates water-jet equipment for wood-cutting experiments in cooperation with the U.S. Forest Products Laboratory.

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New techniques in wood seasoning developed at the U.S. Forest Products Laboratory are passed on to groups seeking up-to-date information.

quently collaborate with the Forest Service in their studies.

The Forest Service arranges for research projects involving universities through cooperative work and by contracts and grants. Examples of the grant research include an appraisal and evaluation of ponderosa pine stumpwood as a source of wood rosin by the University of California; a study of the action of lignin during pulping by the New York State College of Forestry; a study of the basic factors underlying initial infection of wood by decay fungi by the University of Minnesota; environmental factors affecting wood weathering by the University of Wisconsin; and the fundamentals of wood machining by the University of Michigan. These studies have resulted in important contributions to wood science as, for example, the cutting of wood with ruby lasers and water jets.

INDUSTRY

A primary objective of the Forest Service system of forest products research is to do work that is of value to the processors and users of wood. This is accomplished in three general ways:

1. Fundamental and applied research pro-

grams that are in large part planned through continuing consultation with representative technical people from industry and trade associations.

2. Cooperative research agreements that are frequently financed in whole or in part by the industry in search of specific information.

3. A continuous program of technical consultation and information service based on the cumulative knowledge and experience in all known aspects of forest products research. (Recognizing the vast range of technical information needed by industry, the U.S. Forest Products Laboratory has developed a library containing more than 100,000 volumes of related resource material, and it handles an even greater number of technical inquiries and visits to the Laboratory each year.)

The rapidly developing competition from metals, plastics, and other materials is forcing the wood-using industries to accelerate means to improve their operations. More intensive searches for new product outlets and improved manufacturing techniques are required. The vitality of many industries, large and small, and of thousands of communities, including many depressed areas, now depends more heavily than ever on the results of forest products research.

A LOOK AHEAD

A stream of achievements beneficial to wood-using industries and the Nation, plus a closely knit working relationship between the national Laboratory and regional Stations in cooperation with non-Federal research agencies, comprise the record of the Forest Service system of wood utilization research. The 57 pulpmills whose operations are based on the semichemical process, the packaging and pallet improvements, the formulas and techniques for wood preservation, the universally used internal fan kilns for lumber drying, the stressed skin principle of prefabricated wood panels, and many other developments stand as achievements that have returned to the public many times the value of each dollar invested in research.

Faced with increased needs of an expanding population, the demands and pressures placed on research are bound to grow. To meet the country's wood needs requires an expanded and stronger research program in forest products utilization. This program of the Forest Service can be carried out most efficiently within the framework of the present Laboratory-Station system of coordinated research.



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NEEDS AND EXPECTATIONS

The wood utilization problems of today are more difficult than those of the past and are likely to become even more difficult in the future. They center on increasing the serviceability of wood products, on developing new uses for wood, and on improving its quality. To solve these problems requires more basic information—information on wood anatomy, heat and moisture relationships, strength characteristics, wood chemistry, and the mechanics of reactions of biological and chemical agents on wood substances, to name a few.

As a result of this basic knowledge, we expect the future to show a greater variety of wood products in use, with less of the tree going to waste, and more of hitherto unused species finding a place in forest industries. We can expect the development of a chemical industry based on wood as a raw material, better fasteners to join wood and wood products in structures, improved pulping processes for both hardwoods and softwoods, a major reduction in the shrinking and swelling of wood and wood products in use, better paints and finishes, improved technology of structural design, improved adhesives to make better use of low-grade lumber, improved fire resistance of wood, improved log-sawing and seasoning techniques.

In short, the future of this renewable resource—cut from our National Forests and from large and small private forest holdings—is limited only by man's ingenuity in finding more and better uses for it. Good forest management can increase the growth and quality of timber; an effective Federal research organization, in cooperation with other public and private research agencies, can be depended on to transform it in numerous practical, profitable, and as yet undreamed of ways.

Wood, researched into new uses and greater effectiveness, is a prime requirement for an expanding population.



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The greatest possible use of our timber resources, consistent with wise conservation policies, depends on a continuing and effective program of wood utilization research.

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